

Processing and Analysis of aeromagnetic data of North-Eastern Morocco

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Abstract: The North-Eastern of Morocco was widely known for its mining potential, so discovering new structural guidelines was indispensable to find out new mineralization. Indeed, applying airborne magnetic techniques proves its efficiency in underlining new tectonic accidents and highlighting magnetic sources mostly hidden by Quaternary sedimentary covers. A magnetic anomaly map was established to attain this goal, basing on powerful operators (reduction to the pole, upward continuation, and Euler deconvolution), made on airborne data surveys of the study area. The elaborated map shows: (1) zones of strong magnetizations related to the Tertiary and Quaternary volcanic lavas partly outcropping in the Oujda and Saka regions to the iron and manganese mineralization concentrated in the Triassic beds. (2) Zones of relatively low magnetic response came from basaltic cones filled in a small graben at Oujda region. (3) Zones of low magnetization corresponded to the Quaternary and Tertiary cover or the Triassic-Jurassic deposits. We have established a magnetic lineaments map that emphasized deep faults, two main trends have been identified: NE-SW with ENE-WSW and E-W, they are considered as a major's accidents because their depth reach to 2 km, as much as they inherited from the Hercynian and Alpine tectonics.

Keywords: Aeromagnetic surveys, magnetic anomaly, structural mapping, interpreted lineament, hidden faults, North-Eastern Morocco,

Results and Discussion

Sophisticated techniques were utilized for aeromagnetic data. It provided geological and structural details that enormously helped to understand the morphology of the NEM zone.

1- Residual magnetic anomaly

- The intensities range from -170 to +230 nT, and sizes range from a few kilometers to 60 km.
- Three types of anomalies were shown:
 - ❑ Sub-circular anomalies registering a peak of 120 nT (above Guercif town and near to Rchida town).
 - ❑ Complex low amplitude anomalies are found in the Taourirt Oujda Corridor.
 - ❑ Other anomalies situated between Tourirt and Jerrada interfere with each other and line up in a WNW-ESE trend, their intensities are ranging from to 120 nT to 160 nT.

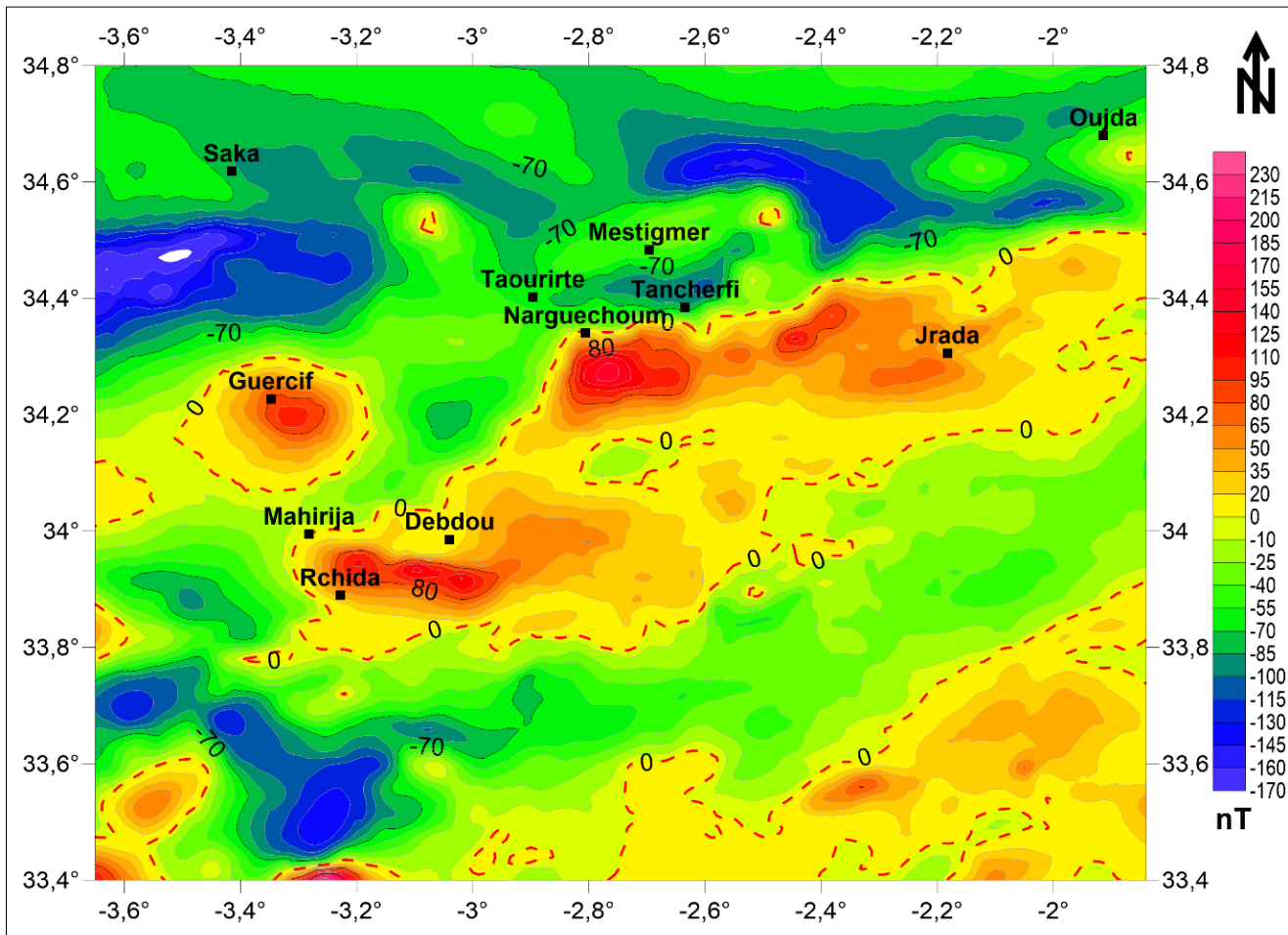


Figure 1: Residual magnetic field map of the study area, the red curve corresponds to 0 nT.

2- Reduced to the pole (RTP) magnetic anomaly

- Anomalous zone (AZ) generally has NE-SW direction and separated the Middle Atlas Basin to the NW from the Jurassic Platform to the SE of High Plateaus.
- N1, N2, N3, N4, and N5 anomalies are probably related to the Tertiary and Quaternary coverage and/or Triassic-Jurassic deposits.
- P1 and P5 relate to the Tertiary and Quaternary volcanic occurrences outcropping in the study area's vicinity.
- The P2 anomaly positioned on the top of the Variscan granites of Debdou. We suggest that are referred to iron oxides in the Devonian basement since granites do not produce appreciable magnetic anomalies.

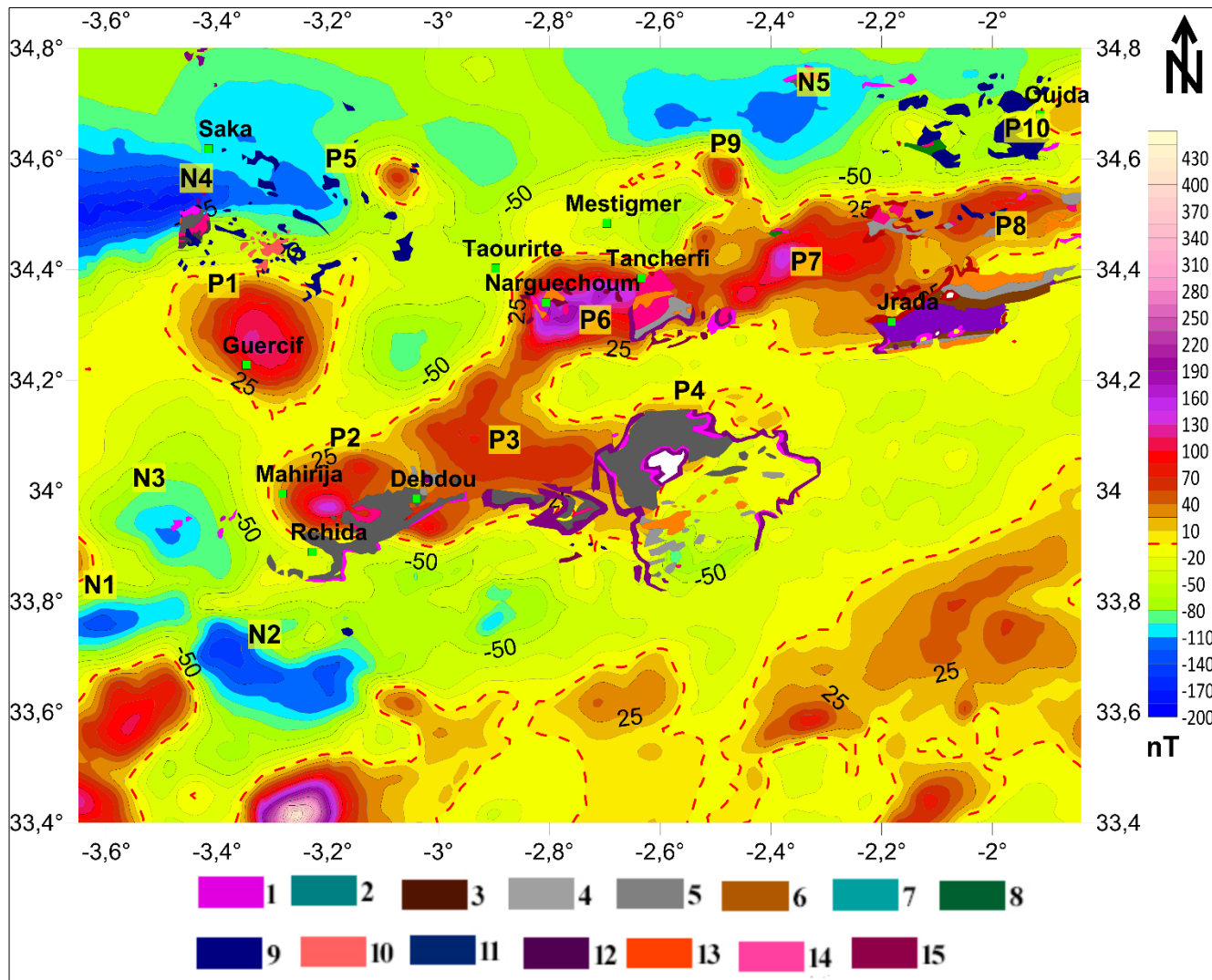


Figure 2: The residual magnetic anomaly reduced to the pole superposed to geological map. 1=Trias 2= Westphalian Namurian and / or Paralic Stephanian 3= Bashkirian Namurian (Béchar) 4=Viseen 5= Devonian Dinant 6=Middle and Upper Devonian 7= Silurian 8= Ordovician 9= Plio-quaternary Ankaratritis Basalts 10= Messinian Trachytes-Rhyolites 11= Pontico-Pliocene Ankaratrites and Diatremes 12= Triassic with undivided basalts 13= Rhyolites Dacites latites Primary Trachy-Andesites 14= Granites of the Hercynian massif 15= Hercynian Dolerites



- P3 and P4 anomalies are maybe caused by the Triassic basalts that enveloped Debdou and Mekkam inliers.
- the P6 and P7 anomalies, which are striking in NE–SW and ENE-WSW directions respectively, are indeed explained by Paleozoic metamorphic basement structures (Tancherfi, Bourdine inliers)
- P8 anomaly is oriented E-W supposed to be related to the Visean volcanogenic complex of Jerada, and/or iron and manganese mineralization.
- P9 anomaly has no evidence on the surface.
- P10 anomaly positioned above on Oujda town is most likely the source of volcanic emissions distributed around the Oujda region.

3- Euler deconvolution

- The interpreted lineaments basing on ED solutions indicate:
 - Major elongated E-W and ENE-WSW faults. They characterize the deep structure setting of the Taourit-Jerada-Oujda zone and their depth reaches 1.5 km.
 - N-S and NE-SW small trends that we interpreted as satellite faults do not exceed 10 km of length.
 - Major ENE-WSW Hercynian fault traversed Jerada basin and presented the extension of a mapped fault. this area was characterized by
 - ENE-WSW, NE-SW and E-W trending faults located From Narguechoum to Rchida (including Horst belt and Debdou region),
- Most of accidents affect the basement and as a result can be inherited at least from Hercynian orogenies.

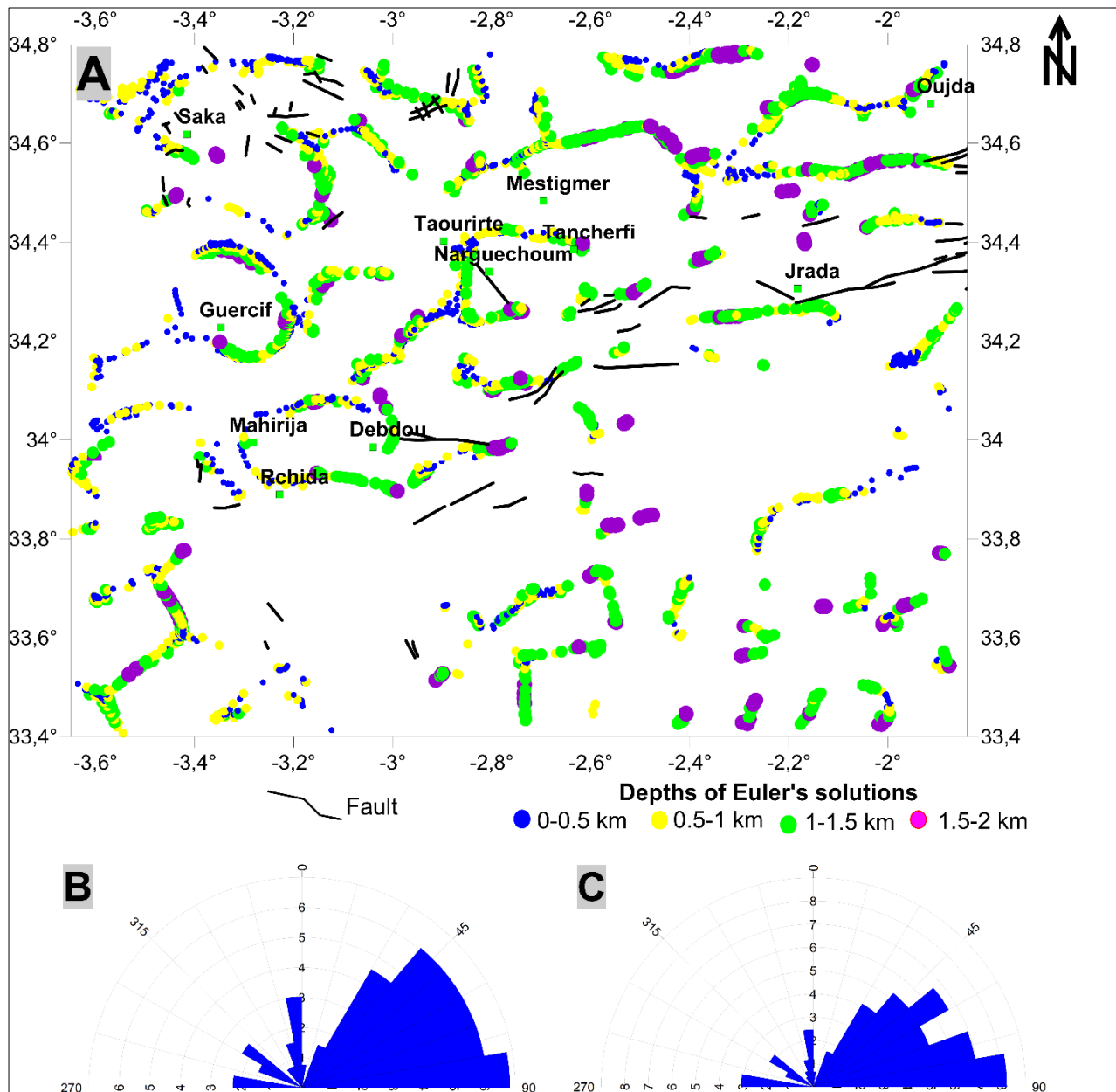


Figure 3: A) Synthetic structural map of the main lineaments and magnetic contacts obtained by Euler deconvolution. Directional rosette of B) Frequency C) Lengths.

Conclusion

Tactic geological exploration highly demanded applying crucial magnetic techniques, Those techniques allow displaying missing information about geological structures of North Eastern of Morocco, Our main findings are:

- ❑ Positive anomalies that recorded high intensity could be related essentially to (1) Tertiary and Quaternary age volcanic lava outcropping in the Saka and Oujda regions.(2) Paleozoic metamorphic basement (Tancherfi, Bourdine inliers...).(3) Iron and manganese mineralization, which are concentrated in the Triassic beds,
- ❑ Negative anomalies, corresponded to superficial formations such as Quaternary and Tertiary cover and/or Triassic-Jurassic sedimentary deposits.

- ❑ E-W fault of Rchida-Debdou that can reach the tungsten mine belongs to Hercynian orogeny so it was a perfect guideline for new mineralization.
- ❑ NW-SE strike-slip faults and ENE-WSW to E-W folds, limited morpho-structural units of Taourirt-Oujda Corridor, belong alpine tectonic because they give rise to alkaline volcanic activities (Aïounites and Mestigmérites) and by Calcalkaline volcanic event well represented around Oujda area.
- ❑ Boundaries faults construct basin boundaries like NE-SW long fault, which separate the Guercif-Tafrata basin and high plateaus. Also, NE-SW fault formed a triangle with E-W, N-S trending faults illustrated under Narguechoum.
- ❑ Most of those accidents did not exceed 2 km of depth and the extension of 80 % of them was less than 1.5 km underground.

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